Project Title: Organic Carbon-Zero Valent Iron Based PRB for Treatment of Arsenic and Heavy Metals

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Problem Definition: The Columbia Nitrogen site in Charleston, S.C. is extensively contaminated with pyrite and elemental sulfur used in phosphate fertilizer production at the site between 1905 and 1972. Sulfide and sulfur oxidation processes (acid rock drainage) have resulted in the subsurface mobilization of arsenic and heavy metals including lead, cadmium, nickel, zinc, and uranium. In addition, the groundwater is characterized by a low pH and high acid-producing ferrous iron concentrations. The contaminated groundwater is impacting a tidal marsh located immediately down-gradient of the site. A pilot PRB consisting of a combination of municipal compost and zero valent iron was installed at the site in September 2002. The pilot PRB, measuring approximately 30 ft in length, 12 ft in depth and 6 ft in width, is designed to treat arsenic and heavy metals through the process of microbially-mediated sulfate reduction.

Background: Sulfate reduction based PRB systems are increasingly being recognized as an effective means of removing heavy metals and arsenic from solution. In the process of sulfate reduction, sulfides are produced which combine with the metals to produce relatively insoluble metal sulfides. In addition, during the microbially-mediated sulfate reduction process, carbonate alkalinity is produced which serves to help neutralize acidity and maintain near-neutral pH conditions. Although promising, organic carbon based PRB systems have not yet been fully evaluated. Questions of key interest include the longevity of the organic carbon based systems, the ability of organic carbon based PRB systems to maintain their hydraulic conductivity properties, and the types of organic carbon substrates most suitable for use in PRB systems.

Objectives: The objectives of the study are to determine whether the compost-zero valent iron PRB system is effective in removing arsenic and heavy metals from the groundwater, whether the hydraulic conductivity properties of the PRB are maintained over time, and how long the PRB remains sufficiently reactive to remove the targeted contaminants.

Approach: Two transects of multi-level bundle well systems have been installed through the PRB allowing for collection of up to 90 groundwater samples up-gradient, down-gradient, side-gradient, and within the PRB. Groundwater samples will be analyzed for multiple parameters including cations, anions, TOC/DOC, TIC/DIC, sulfide, alkalinity, ORP, pH, conductivity, ferrous iron. Comparison of data up-gradient, within, and down-gradient of the PRB will be used to evaluate performance of the PRB. Hydraulic conductivity testing within and outside the PRB will be used to evaluate hydraulic conductivity changes, if any, during the course of the study. Solid-phase analysis will be conducted on core samples collected from the PRB to determine the types of precipitates being deposited and their potential impact on the long-term performance of the PRB.

Accomplishments to Date: Four rounds of groundwater sampling spanning a period of eight months have thus far been completed at the site.

Near Future Tasks: Groundwater sampling on a semi-annual basis will be continued for at least an additional two years. Core samples from within the PRB will be collected in October 2003.